# Chemistry Worksheets Class 11 on Chapter 8 Redox Reactions with Answers- Set 5

**Q-1:** A smuggler could not transport the gold by depositing iron on its surface because
a) Gold is denser
b) Iron rusts.
c) The electrode potential of gold is greater than that of iron.
d) Gold's electrode potential is lower than iron.

**Answer: c)** The electrode potential of gold is greater than that of iron.
Explanation: Gold has higher $E^o$(+ 1.50 V) than Fe (-0.44 V) and hence can oxidise Fe to $Fe^{2+}$. Therefore, the smuggler could not transport the gold by depositing iron on its surface.

**Q-2:** What is the best description of bromine's behaviour in the reaction given below?
$H_2O + Br_2 \rightarrow HOBr + HBr$
a) Both oxidised and reduced
b) Proton donor
c) Proton acceptor
d) Reduced only

**Answer: a)** Both oxidised and reduced
Explanation: Br is in the zero oxidation state in $Br_2$ and is changing its oxidation state from zero to +1 in HOBr and -1 in HBr in the given reaction. As a result, it is both oxidised and reduced.

**Q-3:** A compound is made up of atoms from three different elements: X, Y and Z. If X's oxidation number is +2, Y's is +5, and Z's is -2, the compound's possible formula is
a) $X_3(YZ_4)_2$
b) $X_4(YZ_3)_2$
c) $X_3(Y_4Z)_2$
d) $XYZ_2$

**Answer: a)** $X_3(YZ_4)_2$
Explanation: We know that a compound is electrically neutral in general. The total charge on a compound is equal to the sum of its oxidation numbers. As a result, the sum for the compound $X_3(YZ_4)_2$ is as follows:
3(+2) + 2(+5+(-2)4) = 0.
Because the sum for the compound $X_3(YZ_4)_2$ equals zero, option a) is the correct answer.

**Q-4:** The oxidation state of chromium in $[Cr(PPh_3)_3(CO)_3]$ is

a) +3
b) Zero
c) +8
d) None of the above

**Answer: b)** Zero
Explanation: Because both the $PPh_3$ and CO ligands are neutral, the oxidation state of Cr in $[Cr(PPh_3)_3(CO)_3]$ is 0.

**Q-5:** A standard hydrogen electrode has no electrode potential because
a) Hydrogen is the easiest element to oxidise.
b) This electrode potential is assumed to be zero.
c) Hydrogen atoms only have one electron.
d) Hydrogen is the lightest element.

**Answer: b)** This electrode potential is assumed to be zero.

**Q-6:** Which of the following statements about the electrochemical Daniell cell is correct?
a) Electrons move from copper to zinc electrodes.
b) Electric current flows from the zinc electrode to the copper electrode.
c) Cations move towards the copper electrode.
d) Cations move toward the zinc electrode.

**Answer: c)** Cations move towards the copper electrode.

**Q-7:** $I_2$ and $Br_2$ are added to a solution containing $Br^-$ and $I^-$ ions. What reaction will occur if,
$I_2 + 2e^- \rightarrow 2I^-$ ; $E^o$= +0.54 V and $Br_2 + 2e^- \rightarrow 2Br^-$ ; $E^o$= +1.09 V ?

**Answer:** Since the $E^o$ of $Br_2$ is higher than that of $I_2$, $Br_2$ has a higher tendency to accept electrons than $I_2$. Conversely, $I^-$ ions tend to lose electrons more than $Br^-$ ions. Therefore, the following reaction will occur:
$2I^- \rightarrow I_2 + 2e^-$
$Br_2 + 2e^- \rightarrow 2Br^-$

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$2I^- + Br_2 \rightarrow 2Br^- + I_2$

In other words, $I^-$ ions will be oxidised to $I_2$ while $Br_2$ will be reduced to $Br^-$ ions.

**Q-8:** Arrange X, Y, Z, E, F, and H in order of increasing electrode potential in the electrochemical series if
$X + H_2SO_4 \rightarrow XSO_4 + H_2$

$XCl_2 + Z \rightarrow ZCl_2 + X$
$FCl_2 + Z \rightarrow$ No reaction
$2YCl + E \rightarrow ECl_2 + 2Y$
$H_2SO_4 + E \rightarrow$ No reaction

**Answer:**
**i)** X reacts with $H_2SO_4$ to liberate $H_2$, but E does not. Therefore, X lies above, and E lies below H in the electrochemical series.
**ii)** Further, E displaces Y from YCl. Therefore, the $E^O$ of E is lower than that of Y. That is, E lies above Y in the electrochemical series.
From i) and ii), the order of increasing E° of the four elements is X, H, E, Y.
iii) Since Z is not able to displace F from $FCl_2$ but displaces X from $XCl_2$, the E° of Z is lower than that of X, and that of F is lower than that of Z.

From i), ii) and iii), it is evident that the overall order of increasing electrode potential of these five elements is F, Z, X, H, E, Y.

**Q-9:** Provide stock notation for the following compounds.
a) $Cu_2Cl_2$
b) $Na_2CrO_4$
c) $Mn_2O_7$
d) $V_2O_5$
e) $Cr_2O_3$

**Answer:**
a) $Cu_2(I)Cl_2$
b) $Na_2Cr(VI)O_4$
c) $Mn(VII)O_7$
d) $V_2(V)O_5$
e) $Cr_2(III)O_3$

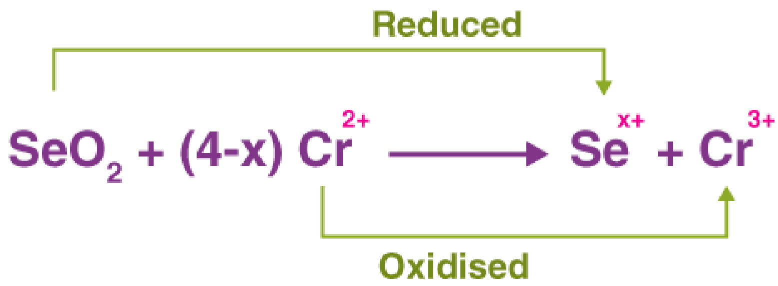
**Q-10:** Find out the ratio of the equivalent weight of $H_2C_2O_4.2H_2O$ as acid and its equivalent weight as a reductant.
**Answer:**
i) Molecular weight of $H_2C_2O_4.2H_2O$ (oxalic acid) = 126
Therefore, equivalent weight of acid = Molecular weight of acid/Basicity = 126/2 = 63.

ii) Oxidation of oxalic acid involves $2e^-$ change. Thus, equivalent weight of $H_2C_2O_4.2H_2O$ = Molecular weight/Number of electrons lost = 126/2 = 63.

Therefore, the ratio of the equivalent weight of oxalic acid as an acid to its equivalent weight as a reductant is 63/63 = 1.

**Q-11:** 12.53 $cm^3$ of 0.051 M $SeO_2$ reacts exactly with 25.5 $cm^3$ of 0.1 M $CrSO_4$, which is oxidised to $Cr_2(SO_4)_3$. To what oxidation state is the selenium converted during the reaction?
**Answer:** Let the oxidation number of Se in the new compound = x






Now 12.53 $cm^3$ of 0.051 M $SeO_2$ = 12.53 × 0.051 = 0.64 millimoles of $SeO_2$ and 25.5 $cm^3$ of 0.1 M $CrSO_4$ = 25.5 × 0.1 = 2.55 millimoles of $CrSO_4$.
But according to the balanced redox equation, (4-x) moles of $CrSO_4$ reduce 1 mole of $SeO_2$.
Therefore, 2.55 millimoles of $CrSO_4$ will reduce $SeO_2$ = 2.55/(4-x) millimoles.
But $SeO_2$ actually reduced = 0.64 millimoles
Equating these two values, we have,
2.55/(4-x) = 0.64 or x = 0.
Hence, the oxidation number of Se in the new compound is zero.

**Q-12:** Sulphite ($SO_3^{2-}$) ions are present in some acid rainwater. What is the amount of $SO_3^{2-}$ ions per litre in rainwater if 25.0 $cm^3$ of this water sample requires 35.0 $cm^3$ of 0.02 M $KMnO_4$ solution for titration?

**Answer:**
**Step-1-** Write the balanced equation for the redox reaction.
$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O] \times 2$
$SO_3^{2-} + H_2O \rightarrow SO_4^{2-} + 2H^+ + 2e^-] \times 5$

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$2MnO_4^- + 5SO_3^{2-} + 6H^+ \rightarrow 2Mn^{2+} + 5SO_4^{2-} + 3H_2O$

**Step-2-** Determine the molarity of $SO_3^{2-}$ ion solution.
Let $M_1$ be the molarity of $SO_3^{2-}$ ions in acid rainwater. Applying molarity equation,
[latex]\frac{M_{1}V_{1}}{n_{1}}(SO_{3}^{2-})= \frac{M_{2}V_{2}}{n_{2}}(MnO_{4}^{2-})[/latex]

$$\frac{M_1V_1}{n_1}(SO_3^{2-}) = \frac{M_2V_2}{n_2}(MnO_4^{2-})$$

We have,

[latex]\frac{M_{1}\times 25}{5}= \frac{35\times 0.02}{2})[/latex]

$$\frac{M_1V_1}{n_1}(SO_3^{2-}) = \frac{M_2V_2}{n_2}(MnO_4^{2-})$$

Or [latex]M_{1}= \frac{35\times 0.02 \times 5}{2\times 25}= 0.07[/latex]

$$M_1 = \frac{35 \times 0.02 \times 5}{2 \times 25} = 0.07$$

Thus, the molarity of $SO_3^{2-}$ ions in acid rainwater = 0.07 M

Molecular weight of $SO_3^{2-}$ ions = 32+48 = 80

Therefore, the amount of $SO_3^{2-}$ ions in rainwater = 0.07 × 8 = 0.56 g/L.

**Q-13:** What is the oxidation number of metals in

i) $[Fe(CN)_6]^{4-}$

ii) $MnO_4^-$

**Answer:**

**i)** Let the oxidation number of Fe in $[Fe(CN)_6]^{4-}$ be x.

Sum of oxidation numbers of all the atoms in $[Fe(CN)_6]^{4-}$ = x+6(-1) = -4

On solving, x = 2

Hence, the oxidation number of Fe in $[Fe(CN)_6]^{4-}$ is +2.

**ii)** Let the oxidation number of Mn in $[MnO_4]^-$ be x.

Sum of oxidation numbers of all the atoms in $[MnO_4]^-$ = x+4(-2) = -1

On solving, x = 7

Hence, the oxidation number of Mn in $[MnO_4]^-$ is +7.

**Q-14:** Give the three points of difference between oxidation number and valency.

| Oxidation Number | Valency |
|---|---|
| 1. The oxidation number is the charge that an atom has or appears to have when it is combined. | 1. Valency is the combining capacity of an element. |
| 2. Because the oxidation number is the charge, it can be positive or negative. | 2. Valency is only a number. As such, it does not have any plus or minus signs attached to it. |
| 3. An element's oxidation number can be zero. | 3. Valency of an element cannot be zero. |

**Q-15:** Select the reducing agent which can reduce the following ions to their metallic state.

a) $Ag^{+}(aq)$
b) $Ni^{2+}(aq)$

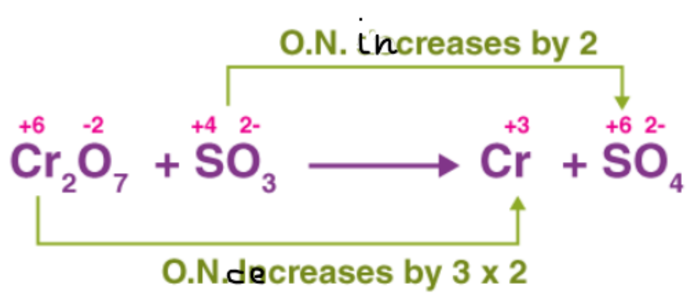
**Answer:**
a) All metals having $E^{O}$ lower than $Ag^{+}/Ag$ electrode, that is, Mg, Al, Ni, Fe etc.
b) All metals having $E^{O}$ lower than $Ni^{2+}/Ni$ electrode, that is, Fe, Cr, Zn, Ca, K etc.

**Q-16:** How can you identify the presence of iodide and bromide ions in the solution?
**Answer:** The layer test is a qualitative test that involves halide redox reactions. This test determines the presence of iodide and bromide ions in a solution. Bromine and iodine are coloured and dissolve in $CCl_4$ and $CS_2$, and these can be easily identified from the colour of their solution.

**Q-17:** Define cathode and anode.
**Answer:**
**Cathode:** The electrode of the electrochemical cell where reduction takes place.
**Anode:** The electrode of the electrochemical cell where oxidation takes place.

**Q-18:** Write a balanced ionic equation for the reaction of $K_2Cr_2O_7$, potassium dichromate (VI), and sodium sulphite $Na_2SO_3$ in acidic medium to produce chromium (III) ion and sulphate ion.

**Answer:** The Skeleton equation is
$Cr_2O_7^{2-} + SO_3^{2-} \rightarrow Cr^{3+} + SO_4^{2-}$




$Cr_2O_7^{2-} + 3SO_3^{2-} \rightarrow 2Cr^{3+} + 3SO_4^{2-}$
$Cr_2O_7^{2-} + 3SO_3^{2-} \rightarrow 2Cr^{3+} + 3SO_4^{2-} + 4H_2O$
$Cr_2O_7^{2-} + 3SO_3^{2-} + 8H^{+} \rightarrow 2Cr^{3+} + 3SO_4^{2-} + 4H_2O$

**Q-19:** Calculate the average oxidation number of C in $CH_3COOH$ compound.
**Answer:** The oxidation number of carbon attached directly to hydrogen atoms in $CH_3COOH$ is -2, while that of carbon attached to oxygen is +2. The average oxidation number comes out to be (-2+2)/2 = 0.

**Q-20:** Why is electrode potential also called the potential for half cell?

**Answer:** Electrode potential is the tendency of an electrode to lose or gain electrons. Because each electrode represents a half cell, the electrode potential is also known as the potential for half cell.